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Interest rates and housing cycle: The case of southern Europe

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Contents

Abstract.

House building in Spain has been very active along nineties. This fact used to be explained by the coincidence of various economic reasons generating Spanish house building cycle to be one of the most actives in Europe. There are endogenous reasons to the Spanish economy to explain this phenomena, but also exogenous ones that have the characteristic to be common to others European countries. The fall on interest rates as well as inflation, are common features resulting from the process of euro introduction, and they have had similar intensity in others European countries, as Italy and Portugal, that have not experienced such housing boom as in Spain. This paper tries to explain how the expansion on house building can be due to these general economic changes and to deep on the role of interest rates as common feature to explain Spanish, Portuguese and Italian housing cycle during last nineties and its different effect. Some output of this paper are to contrast how interest rate affect housing cycle in the long run, through its permanent components, specially the trend. Long run and stable behaviour have permanent effects and seems to be affected by EMU process in the case of Spain.

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INTRODUCTION

The characteristics of housing as economic good and its dependence from general economic variables determine differences on housing market behaviour depending on which the geographical area is. Particularities on productive systems and determinants of residential demand and supply, market balance formulas and dynamism are different in each region, generating responses differently in housing cycle along region and countries, instead of they are influenced by similar economic facts shocks. This fact has generated to accept the principle of 'locality' on residential markets and the necessity to analyse demand and supply particularities separately to know in-depth mechanisms that influence on them[1].

During ninety, some structural changes related to the integration process have happened in Europe, first in terms of the opening market (Single Market), and then with the euro-introduction process. Both processes have change the behaviour of some economic variables with effects on the housing market and they have been able to affect to the cycles behaviour among areas. In the case of Spain, an unusual expansion have taking place following these changes, doing that housing starts reach the historical maximum (from the last fifty years) in a process not very well known: Traditionally movements in long-time demand factors have been produced influencing growth on housing stock and consolidating the larger Spanish residential markets, as Madrid, Barcelona and main province capitals (Taltavull, 2000). From eighties, a part of the housing cycle expansion seems to be due to the progress on housing wealth in the household's portfolio (Taltavull, 2001a) and all housing growth from sixties has been produced in an environment characterized by an important inflation (18% on average during seventies, 7% on eighties) and high level on interest rates (average of 16% until nineties and more than 10% until 1997).

In other European countries, as Italy and Portugal, the evolution in terms of inflation and interest rates has been very similar than in Spain, and all of them have seen how from 1997 both economic variables have experienced a dramatically reduction because to the euro introduction. Coinciding to this process, housing cycle began to rise showing different intensity on three countries, achieving the most important growth rate in the case of Spain, but not in Italy or Portugal.

During all the process, some macroeconomic analysts have contrasted how a part of the general investment is addressing to housing market in some European countries (FMI, World economic outlook, 2000, and Bank of Spain, 2001), but it is not clear why capital flows decided to enter on housing markets, when they come and the way through they do it, if

[1] A resume of different focus are in Meen and Andrew,1998

it is because low inflation, lower interest rates or/and expectation about them and, more important, why the capital flow is driven more intensively to one country and not in others . Some evidence for Spanish case are about inflation expectation in Taltavull,(2001b), but not about the effect on which the role of mortgages interest rates has been to address housing supply/demand. However, interest rates role in housing market analysis has been very focused in the literature[2], but always being use as an indicator of financial equilibrium and housing costs.

The aim of this paper is to contrast how interest rates changes can explain housing trend and cycle during last twenty years, if housing supply adopt an stable behaviour with regard to the real interest rates evolution, and specially the important shift on housing starts at the end of the nineties. The organisation of this article is as follow. First section explains changes on economic variables evolution due to monetary integration process in Europe focusing in Spain, Portugal and Italy. Part two includes housing literature that analyse interest rates and house building and how they use to be related. Part three explain data and sources, part four include the empirical analysis comparing housing cycles in the three countries from Southern Europe. The following section includes a discussion and interprets the results of the exercise. Finally, conclusion is provided.

1.- The euro introduction process and housing cycle in Spain, Italy and Portugal

Mechanisms explaining Spanish residential growth appear to be related to changes on demand determinants in the long run. These factors are demographic and economics, as changes in migration model, the per capita income growth and the rise on employment, and as a consequence of their general effect, have had cross influence in terms of geographic areas. General knowledge specificity how local markets have their 'own and different cycles' depending on the characteristic of geographical areas (RICS, 1994) defining a region-specific housing behaviour with their own phases when any external economic shock occurs. Other research show how housing market are linked to others economic sectors receiving and causing persistent effects each other (Wang, 2001), and probably producing that housing

[2] There are many references to the role of interest rates in housing market equilibrium, from first research in cycles, as Guttentag,1961, Alberts, 1962, including Samuelson, 1960, more modern focus, as in Barras and Ferguson, 1987 and Smith, Rosen and Fallis, 1988. Nineties have seen an important improve on ARIMA analysis techniques and cointegration applied to real estate and housing market, which include models focused

cycle are linked between regions, as much as their economies are integrated. Some research show the existence of a relationship between development housing activity pattern among areas, contrasting that a leadership effect from one to others exists as if a locomotive effect was in residential construction (Green, 1997). Tse, Zietz and Greer(1998) also show how a long period relationship on residential activity in American housing markets exist, and how South and West regions are leaders on changes in construction development, previously to the generalisation on the housing cycle in domestic market.

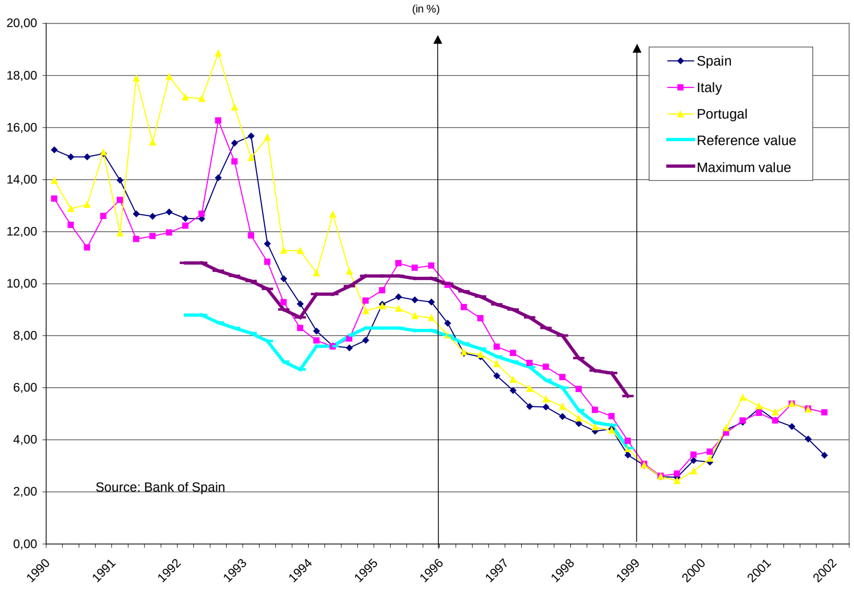
The idea of the existence a feedback effect among areas appears also in Spain, when local residential market's analysis of different regions is made, (Taltavull, 2000) adding empiric experience to the others.

EXHIBIT 1.- NOMINAL CONVERGENCE CRITERIA TO EMU ENTRANCE		
INFLATION	Average inflation of 3 EU countries with less inflation + 1,5	
INTEREST RATES	Average interest rates of 3 EU countries with less i.r + 2	
%PUBLIC EXPENSES/GDP	maximum 3%	
%PUBLIC DEBT/GDP	maximum 60%	
EXCHANGE RATE	maximum floating 15% around max and min. margin. last two years and no devaluation of the currency	

Integration process in Europe is going to have the effect to unify the evolution of macroeconomic variables affecting to housing market. It was during second half of nineties decade when euro has been introduced in the world. Physically early 2002, but the process

GRAPHIC 1.- INTEREST RATES IN CONVERGENCE CRITERIA PERIOD

(in %)

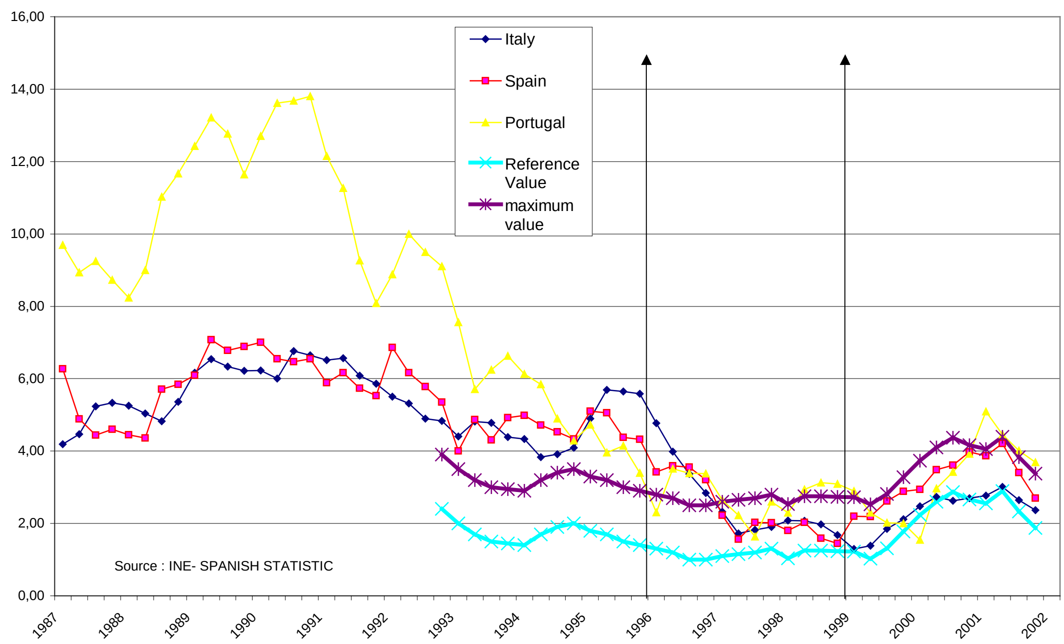


more in other variables than in the interest rates role. See Case, Goetzmann and Rouwenhorst, 1999, Wang, P, 2001, and Ortalo-Magné and Rady, 2001.

began, firstly, coordinating monetary policies from 1990. Process was intensify from 1995 changing and unifying financial accounting and control until 1997, for ‘economies‘ exam’ from 1996 to last 1998, until the first phase of euro began on January, 1, 1999 for all countries (but Greece) included in the Single Currency. Candidates’ countries had to transfer sovereign in monetary matter and to apply (at the same time) important economic measures on fiscal policy in order to carry out their compromise to reach euro. These measures are known as ‘*nominal convergence criteria*’ (table 1) and concretely the inflation and interest rates (addressed in a centralised monetary policy by European Central Bank) are related strongly to housing behaviour. Process was followed by all countries candidates, showing a strong adjustment last two years of the period, as it can see in graph 1 and 2 for interest rates and inflation. Reduction on interest rates was dramatically strong, especially in two last years but very concentrated during seven month from September of 1997 until February of 1998 in Spain, Italy and Portugal. Inflation fell at a similar rate until its minimum value, some less than 2%. After 1998, changes on these indicators are similar reflecting same policy and economic influences.

If macroeconomic variables tend to have a similar evolution in all European countries as the integration process go ahead, then housing market could become ‘global’ and transfer influences to local housing markets along Europe in the same address. The three countrieì¥Á□9 □□□ø□¿□□□□□□□□□□□□□□□□§ú□□

GRAPHIC 2.- INFLATION CONVERGENCE CRITERIA TO EMU



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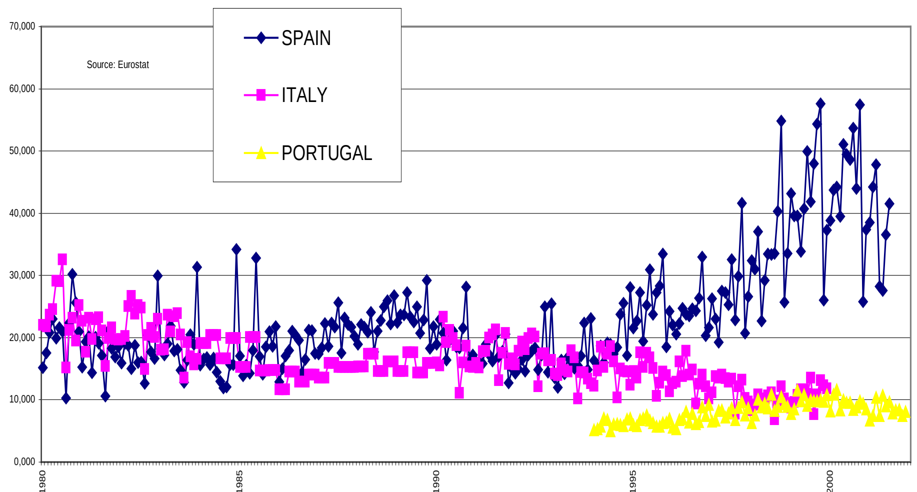
So dramatically drop on interest rates has to have had similar effects on all three housing cycles, also in Italy, specially knowing that the Italian economic structure is close to the Spanish one in terms of the economic specialisation (traditional manufacturing and also in advanced industrial goods, with a strong service sector specialised in tourism, and common agricultural product, all of them with very export focus). It is difficult to admit that the impact of a similar macroeconomic process do not have a similar effect on housing demand and push development, at least, inside a close pattern.

The aim of this paper is try to contrast the impact of real interest rates on housing investment, extracting the behaviour pattern that relate house-building and interest rates and, then, focusing on nineties in order to check the differences in market behaviour among the

GRAPHIC 3.- HOUSING NEW UNITS EVOLUCION IN SOUTHER EUROPE



three countries. In fact, we try to find evidence about how interest rates evolution is linked with construction process and if housing cycle shows some time-pattern with lag relationship. Analysis developed here uses the new housing units series as a proxy of housing investment. Because interest rates affect both demand and supply side, lag-relationship can explain us how interest rates affect to market improving construction.

2.- Literature review

Interest rates are included in many of the literature about housing market that follow the classical point of view. According to it, interest rates are on of the determinants of housing cycle both from the demand and supply side. It is a common thought to assign them responsibility **in short run** waving, contributing to the balance process in housing market. The pioneers research (Guttentag, 1961, Maisel, 1963) contrasted how changes on interest rates (approximated by bonds return rate) had a systematic relationship with housing cycle in the short run, meaning that housing construction adapted its evolution to changes on interest rates (Lewis, J,1959, Schaaf, A, 1958, Grebel, L,1959, Smith, W, 1958, Alberts, W, 1962,). Theory of residual funds, (Guttentag, 1961, and Alberts, 1962) explain how flow of capitals to finance housing comes from the market alternatively to others economic activities, it is say, construction received funds from capital markets when interest rates fall because the existence of an economic crisis in other economic activities than housing (Smith, Rosen and Fallis, 1988). Similar results has been found in more modern research extracting cycles using spectral analysis (Clemhout and Neftci,1981, Barrás and Ferguson, 1988), showing that interest rates are the transmission element of impulses from financial market to housing market. Muth, 1988, add a persistent effect of a change on interest rates, calculating as a change maintained during a year is reflected on housing market until the fifth year after the shock happened.

From eighties, interest rate use to be included inside the concept of housing use cost (ω) to estimate the joint effect with other variables to balance the market in the short run. I.r. is seen as a cost to own a house, as the following expression explain (Poterba, 1984, Arnott, 1991, Engelhardt and Poterba, 1991):

:

$$\omega = [\delta + k + (1-\theta)(i+\mu) - \Pi_H].$$

Where:

i interest rates.

'θ' tax rate .

d depreciation rate

μ property taxes

π Expected inflation.

Π_H real housing prices = p_h/p

Some of authors of the literature express that direct relation between interest rates and housing are difficult to measure, giving often spurious results to them.

Some others research find that the true link between interest rates and housing market is in **the long run**, because long run has specific determinants with very stable behaviour, as demographic, permanent (or current) income, and also finance through which long term interest rates affect to the market. Interest rates use to be include inside tenant decisions models (Hoffmeyer and Mordhorst, 1968, and also Alberts, 1962 and Guttentag, 1961), because: " Interest rates are the cost to differ goods and services consumption in time, and no only the cost for mortgages. Process of growth interest rates incite to families to differ durable goods buys and on the contrary … modifying their saving position when interest rates are increasing…." (Arcelus y Meltzer, 1973, 81) finding both positive and negative correlation between housing construction and interest rates because it is the result of two separated relationship: high interest rates persuade to families to differ indebtedness decisions and durable good consumption, and induct their saving to jump from finance assets to real estate assets.

Some research found that interest rates affect to housing market through housing prices (Ståhl, 1968, Büttler y Beckmann, 1980, Dougherty y Van Order, 1982, Muth, 1988,) where majority position is that interest rates affect to rent price on housing market decreasing demand and reducing development activity. On the contrary, a drop in interest rates yield increases in housing prices and transaction (Ortalo-Magné and Rady, 2001).

From the investment point of view, a change on interest rates is important because it modify housing returns and cost equilibrium, making capital flow to address to different assets depending on the return evolution.(Hess, 1973, Gillingam, 1983). This mechanism use to be important, especially when housing demand is driven, mainly, to become owner.

Interest rates behaviour caused that a credit restriction appears in housing market during sixties and seventies (Maisel, 1963, De Rosa, 1976, Swan, 1970, Jaffe and Rosen, 1978, Jaffe y Modigliani, 1969). Also from eighties, this relationship appears to be maintained inside investment decisions in portfolio (Hendershott, 1989, Lekkas, Quigley and Van Order, 1993, Barras and Ferguson, 1987) supporting the existence of a substitution principle between investment on housing and other assets addressed by interest rates. Recent research use to include interest rates as an update factor to calculate property returns in order to estimate real estate cycles (Case, Goetzmann and Rouwenhorst, 1999, Wheaton, W. 1999).

In order to show how interest rates changes affect to household demand, we have to take into account the restrictive conditions that households find to get a mortgage for ownership purposes. Housing construction (new units investment) also depends on how affordable is a house for residents, so, if household do not afford a house, it never will get a mortgage and housing investment do not rise. Housing affordability depends on the following ratios (that use to be applied in financial sector before give a mortgage (Taltavull, 2002)):

$$\mathbf{Afford} \iff \mathbf{f(Rs_{it},\ Re_{it},\ Rcv_{it},\ Rm_{it}\ ,\ Ah_{it}\ ,\ Is_{it}\ )}$$

Knowing that :

$$Rs_{it} = [\,P_{it} / Is_{it}\,] \qquad i = 1\ldots n \quad , t = 1 \,..T$$

Where:

P_i = House price of a unit with 90 m2 square metres (average are a surface of housing stock in Spain) in the region i at the time t.

Is_i = Total annual waged income in each professional category for the proceeding year in the region i at the time t.

$$Re_{it} = [\,\Sigma_{j=1,12}\, A_{ij} / Is_{it}\,] \,{*}100 \qquad \text{With } i = 1\ldots n$$

Where:

A_{ij} = is the monthly mortgage repayment including payback and interest charges during period *T* of the credit life. This amount is calculated as a yearly constant quantity of repayment that depends of the average of mortgage in each region i a standard mortgage interest rate in the market. It is say:

$$[\Sigma_{j=1,12} A_{ij}]_t = A_{it} = f\,(Cm_{it}, r_{it}) \qquad \text{Where:}$$

Cm_{it} = Amount of mortgage average credit granted in region (i) in the moment (t).

r_{it} = average interest rate for mortgages in region (i) at moment (t).

Is_i = Total annual waged earning income in each professional category a year proceeding in the region i at the time t.

$$Rcv_{it} = [\,Cm_{it} / P_{it}\,] = 80\% \quad , \text{ that means} \quad Cm_{it} = [\,P_{it} \times 80\%\,]$$

$$Ah_{it} = [\,P_{it} - Cm_{it}\,] = [\,P_{it}\,(1 - Rcv_{it})\,] = P_{it} \times 0.2 \qquad \text{Where} \quad i = 1\ldots n$$

$$Rm_{it} = T > 12 \text{ años (maturity ratio)}$$

Transforming this expression,

$$F(P_{it} / Is_{it}\;, A_j / Is_{it,}, Cm_{it} / P_{it}\,, \;T_, \;Ah_{it}\,, Is_{it}\;)$$

And operating on it:

$$\text{Afordability} \Longleftrightarrow f(\,Is_{it}, P_{it}\,, r_{it})$$

That means demand to own a house depending on how much the salary revenues increases above residential prices rates, and/or the evolution on interests rates. As some research contrast, each market has an associated cycle with particularities that depends on their endogenous characteristics, (Wheaton, W, 1999, Case, Goetzmann and Rouwenhorst, 1999, Pyhrr, Roulac and Born, 1999, Wang,P, 2001) both in geographic and in real estate sectors, that means Is_{it} and P_{it} are specific elements on each market. Instead of that, interest rates are common elements in all housing markets.

Because main housing demand during nineties in Spain, and also in Italy and Portugal, comes from first homers (main use demand) and second houses buyers, and in order to analyse aggregate data, in this research we try to deep in the role which interest rates has had in last nineties to facilitate ownership and the housing building process and also if this role has been the same than in the past or, on the contrary, there is a new pattern of behaviour.

It is say, considering Is_{it}, P_{it} two exogenous variables, we try to contrast how housing cycle is link to interest rates and their lag-model,.

$$Hcycle = f(r_{it})$$

and if it is maintain during nineties, when structural changes on the economy was made.

To do that, we need to focus in long and short term analyzing the nature of relationship. So, we have to decompose the unobservable components included in the original data. As it is usually to find, economic data presenting time swings evolution use to have various components combined, as trend, short term cycle, seasonal and random, with different temporal pattern that are needed to know (Gómez and Maravall, 1998) extracting them correctly, in order to estimate the clear and robust linkages between housing and the interest rate. .

In the follow section, steps to decompose data are explained and showed results.

3. – Model and data description

Analysis here develops two steps. First, time components of housing series are calculated estimating cycle, trend and seasonal behaviour in the three countries. Second, we fit each component with interest rates in differences following the suggestion of literature.

Methodology use for **first stage** is based in the traditional concept of unobserved component in a time series, also known as 'unknown models'. We checked two possibilities looking for the best way to decompose time series according to our interest. First one was the methodology developed to obtain short-term analysis and forecast. Following Kaiser and Maravall, 2000, environment to do this is the approached for decomposition so-called 'Structural Time Series Model', that specify models for the components and ignores the model for observed series. A trend component, p_t, will follow a model as,

$$\nabla^{\delta} p_t = \theta_p (B) a_{pt}, \qquad (1)$$

Where d= 1,2 and θ(B) is lag operator of order <=2; a seasonal component, s_t

$$S s_t = \theta_s (B) a_{st}, \qquad (2)$$

With θ_s (B) with relatively low order polynomial in B. Irregular components are often assumed white noise or some transitory ARMA model. A limitation of this approach is the 'a priori' structure imposed to the series. This limitation is overcome in the so-called ARIMA Model Based approach, where the starting point is the identification of an ARIMA model for the observed serie and deriving the rest of the components. The models obtained for the trend and seasonal components are the type (1) and (2) and decomposition yield a white noise or a transitory ARMA irregular components. So, for quarterly data series and assuming the model is given by an expression as,

$$\nabla\nabla_4\, x_t = \theta\,(B)\, a_t, \qquad a_t,\ \text{is niid}(0,V_a) \qquad (3)$$

being x_t the observed series and assuming a model invertible, a_t is a double identified distribution, with media 0 and finite variance ($n_{iid}(0,V\alpha)$) and B is lag operator. Components are derived as the basic features of a trend, a seasonal and an irregular component. Considering that $\nabla\nabla_4$ factorises into ∇^2 S, then ∇^2 is an AR $\Phi_p(B)$ polynomial representing the trend component and an AR $\Phi_s(B)$ polynomial for seasonal component. Series, then, contain nonstationary trend (trend-cycle), seasonal components and irregular components, as:

$$X_t = p_t + s_t + u_t \qquad (4)$$

When Φ (B) has an order <= 5, we can obtain the following components:

- Trend.cycle, $\nabla^2 p_t = \Phi_p(B)\, a_{pt}$, a_{pt} n_{iid} (0,Vp), (5)
- Seasonal component: $S\, s_t = \Phi_s(B)\, a_{st}$, , a_{st} n_{iid} (0,Vs), (6)
- Irregular component, u_t is a niid(0,Vu),

Where the two "a" are uncorrelated white noises, ∇^2 is a lag operator that distribute the series as an Ar(p) being S an operator Ar(s). With ARIMA models, equations (4), (5) and (6) using no observed data can be estimated, that means this method is a useful tool to adjust time components without need information from observed data, and with relatively good results in short-term analysis, that means we can estimate,

But if we can estimate same components but in a more longer period, ARIMA use to give many errors, so, in a long-term overview, process in practice use to be extract a deterministic trend and the rest of unobserved components from the original data using filters ad-hoc. This was our second method applied here with better results. We use two filters "ad-hoc" incorporating the very known methodologies modelling with moving averages, as filter Holdrick-Prescott, to calculate long run components (trend-cycles), and X11Sa filter to components for very short term, are used.

Limits to use of those filters are similar to a restrictions imposed to short run –ARIMA method without observed data. As they incorporate presumption of previous behaviour (fixed characteristics), there are experiences to have spurious results specially when filters are applied on estimated data and not on original observation. This means that we have to apply the seasonal filter on original data first, and then to extract trend-cycle signals. Secondly, we have to take care that resulting series from first filter perform two conditions more, that are: series to be stationary and, secondly, they have to have a normal distribution (better it they have a mean zero and finite variance). In practice, stationary imply to dispose of series with mean constant, and they can be achieve through transforming in logarithm and/or differencing original data. Fist transformation is appropriated when the length of waves increase with the level. Also, differencing have the effect to reduce seasonal component if differences are each four quarters, cancelling a periodic deterministic function that repeat each period, so, differences remove trend components in series but no the stochastic component, that are, by definition, a short run characteristic. Then, differences are useful to analyse series in short run, but not in long term, reason why we use her the logarithmic transformation.

Hôdrick-Prescott (HP) filter is considered as the optimum to estimate equation (5). Technically, it is a lineal estimation computing smooth series '*s*' from '*y*', minimizing the variance of *y* respecting to *s*, subject to restriction imposed by the second differences of *s*. It means minimize the following expression:

$$\sum_{t=1}^{T}(y_t - s_t)^2 + \lambda \sum_{t=2}^{T-1}((s_{t+1} - s_t) - (s_t - s_{t-1}))^2$$

When λ tend to infinite , filter approach a trend line for long term.. For quarterly data, we take an arbitrary-most extended decision, making $\lambda = 1600$

We have to think that trend obtained with procedures explained before may contain a large amount of relatively short-term variations. The existence of trend with cyclical frequencies is a result of the implicit definition of the trend in the decomposition method using HP filter and means that trend component is compose for two types of trends (Gómez y Maragall, 1998, pag. 48):

$$p_t = m_t + c_t \qquad (7)$$

- Where m_t is an historical cycle or long term trend
  $+ c_t$ is short run cycle.

Both can be estimated with the same sort of cycle estimation method. Decision in this research was use X11sa, contrasted some cases with Holt-Winters filter.

Holt Winters method imply to calculate an estimator such that:

$$\hat{Y}_{t+k} = a + b_k + c_{t+k}$$

where *a* and *b* are the permanent components (intercept) and the trend, being *C* seasonal factor.

$$a(t) = \alpha(y_t - c_t(t-s)) + (1-\alpha)(\alpha(t-1) + b(t-1))$$

$$c_t(t) = \gamma(y_t + a(t-1)) - \gamma c_t(t-s)$$

$$b(t) = \beta(a(t) - a(t-1)) + 1 - \beta b(t-1)$$

Where frecuency is stational when = $0 < \alpha, \beta, \gamma < 1$

X11 filtering is a methodology very known and used and it is known as a filter-family composed by different filters, including X11SA and X12. It is an standard method that use moving average- additive (it is the selected here) that suppose that, to filter y_t:

1. First compute the centered moving average of y_t as (for quarterly data):

$$x_t = (0.5^* y_{t+2} + y_{t+1} + y_t + y_{t-1} + 0.5^* y_{t-1}) /4$$

2. Then, we take the difference $d_t = y_t - x_t$

3. Compute the seasonal indices. The seasonal index i_q for quarter q is the average of d_t using observations only for quarter q.

4. We then adjust the seasonal indices so that they add up to zero. This is done by setting $S_j = i_j - i$ where i is the average of all seasonal indices. These s are the reported scaling factors..

5. The seasonally adjusted series is obtained by subtracting the seasonal factors S_j from y_t .

For the purposes of this paper we have to estimate p_t , m_t and c_t (7) of the new housing units series, in Italy, Spain and Portugal. In order to maintain information from observed data and to contrast the long term pattern and if it is maintained during nineties, we decide to extract deterministic trend implicit in data and observe how it behave and grow. We follow the process explained above in the series and we expect that:

m_t is the long term trend, is integrated

c_t is stationary

In the second step of this paper, we estimate relationship between components calculated and changes on real interest rates (ir), in order to observe nature of the relationship. So:

$$m_t = f(ir)$$

$$c_t = f(ir)$$

We expect to find the sensibility of each component to changes on interest rates in order to describe permanent behaviour in the long and short run pattern. Following the literature, long run relationship must appear using this step. Short run impact between two indicators can arise because the lack on stationarity on m_t and c_t using Error Correction Models to estimate the equations, both in trends and cycles, giving us the lag between variables. And because indicators are measure in log terms, elasticities obtained in the exercise allow to us to have a first approach to the different reaction existing among the housing market in the three countries.

- Data sources and computational aspects

The computing process follows the next steps:

Firstly, we eliminate seasonality from time series that is the most transitory component, using X11sa filtering.

Secondly, we extract the trend using residual from previous estimation.

Thirdly, we extract the rest of the components

Data use here, sources, periodicity and period is in exhibit 2

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EXHIBIT 2.- DATA AND SOURCES				
Name	**Country**	**Source**	**Available period**	**periodicity**
Housing Starts	Spain	MFOM	1980-2002	Quarterly
	Italy	Eurostat	1980-1999	Quarterly
	Portugal	Eurostat	1994-2002	Quarterly
Interest Rates	Spain	INE (Spanish National Statistics Institute)	1980-2002	Quarterly
	Italy	International Monetary Fund Database	1980-2002	Quarterly
	Portugal	International Monetary Fund Database	1980-2002	Quarterly
Consumer prices (index)	Spain	INE	1980-2002	Quarterly
	Italy	INE	1980-2002	Quarterly
	Portugal	INE	1980-2002	Quarterly

Data used in this paper is from the Spanish National Statistical Institute database, International Monetary Fund database and Eurostat. All of them but interest rates were monthly and they have been converted using additive method, in the case of housing starts, and last observation in the quarterly, in the case of price index. All series are homogeneous and comparables.

The stages of the analysis are:

1**.- Firstly**, we transform each series in logarithm terms, analysing the stationarity and normality on each transformation.

2.-**Secondly**, We estimate components included on (7) as defined above, extracting long term trend and short cycles in housing, that are m_t and c_t, named in the exercise hp_t and cy_t

$$g_t = \overset{\circ}{hp}_t + \overset{\circ}{cy}_t$$

Once calculated m_t y c_t, we apply same stationarity and normality test in order to be sure that results do not violate theoretical assumptions to have significant meaning and not spurious ones.

3.- Thirdly, we regress each component with interest rates as:

$$hp_t = f(ir_t) \qquad (8)$$

$$cy_t = f(ir_t) \qquad (9)$$

using an ECM, i.e.

$$\Delta y_t = \alpha[\mathbf{y}_{t-1} + \beta\mathbf{x}_{t-1}] + \Gamma(\Delta\mathbf{y}_{n-t}, \mathbf{x}_{n-t}) + \mathbf{u}_t$$

$$\Delta x_t = \delta[\mathbf{x}_{t-1} + \sigma\mathbf{y}_{t-1}] + \eta(\Delta\mathbf{y}_{n-t}, \mathbf{x}_{n-t}) + \mu_t$$

Where y_t is long term housing cycle

x_t is changes on interest rates

α, δ scalar constant representing the long run effects of those variables

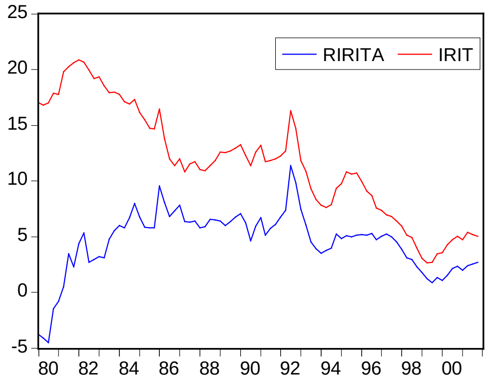
Γ, η are parameter vector to lagged variables representing the short run effects.

$u_t\ \mu_t$ error terms

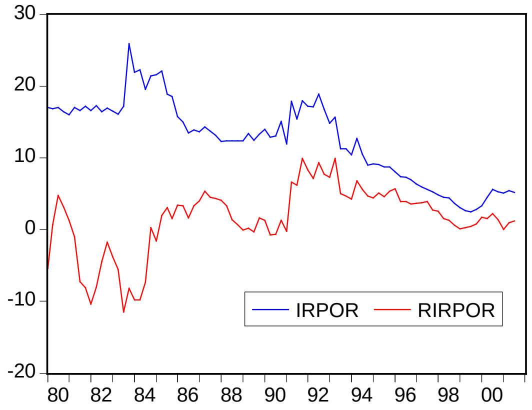
Parameters Γ, η show the sensibility of both cycles.

Interest rates are computed in real terms, i.e. $ir_t = Ir_t - \Pi_t$. Evolution is shown in graphic 4a,b and c

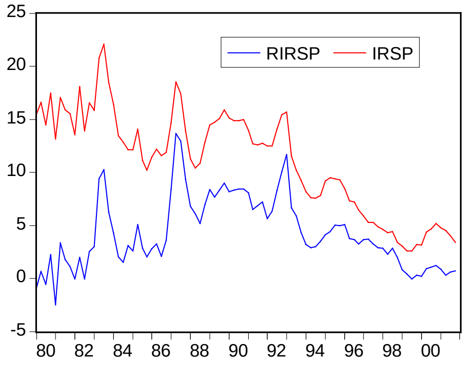
Graphic 4 a- Interest rates in Italy



Graphic 4 b, Interest rates in Portugal



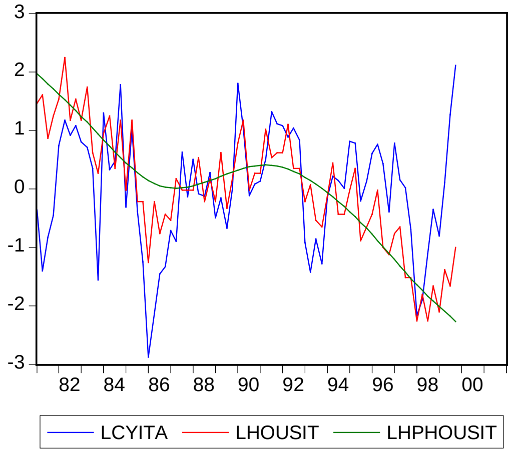
Graph 4c- Interest rates in Spain



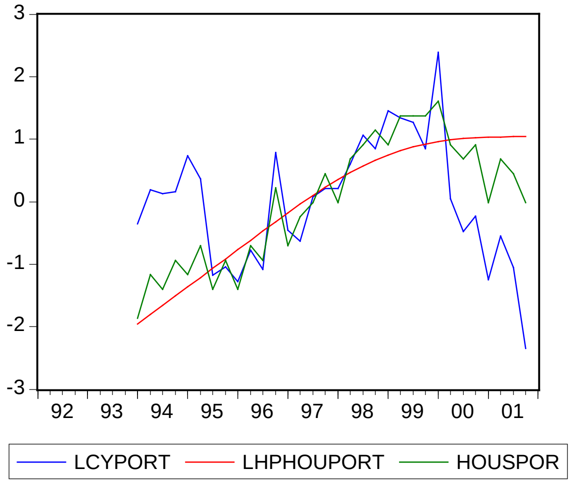
4.- Empirical results

Original series can be shown in graphic 5, 6 and 7 for long term trend and short run cycle. Short run cycles are obtained after calculate original series seasonal adjusted from resid resulting from adjust transformed serie and its long trend term.

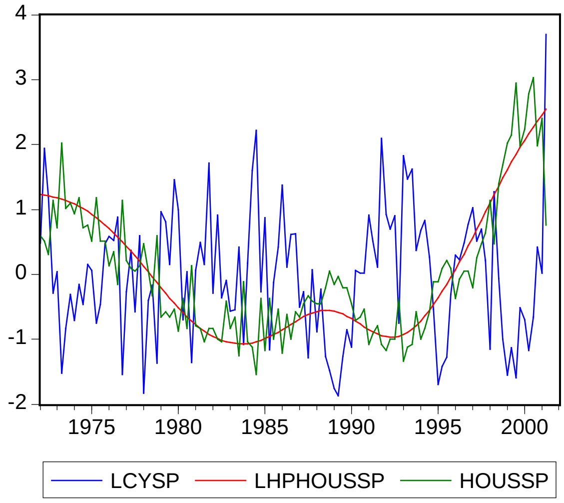
GRAPHIC 5. HOUSING STARTS IN ITALY. LONG TERM AND CYCLE



GRAPHIC 6.- HOUISNG STARTS IN PORTUGAL. LONG TERM TREND AND CYCLE



GRAPHIC 7.- HOUSING STARTS IN SPAIN. LONG TERM TREND AND CYCLE



Stationarity contrast are in exhibit 3. All long term trend series are non-stationary and all cycles series are stationary and normal, with mean cero and finite variance. Only Portugal-cycle is not stationary because the short period of observed data.

Exhibit 3.- Stationarity contrast for housing series.

		Original series		Short term cycles		Test critical values			
		level	first differences	level	first differences	**1% level**	**5% level**	**10% level**	
ITALY		**I(1)**		**I(0)**					
	ADF- test	-1,681	-4,0805	-4,205	-	-3,520	-2,901	-2,588	original series
	P.Perron test	-2,944	-24,452	-4,322	-	-3,516	-2,899	-2,587	short term cycle
PORTUGAL		**I(1)**		**I(1)**					
	ADF- test	-1,766	-12,094	-1,969	-7,3118	-3,670	-2,964	-2,621	original series
	P.Perron test	-2,366	-11,207	-1,9856	-7,4725	-3,662	-2,960	-2,619	short term cycle
SPAIN		**I(1)**		**I(0)**					
	ADF- test	-1,326	-9,281	-4,369	-	-3,488	-2,887	-2,580	original series
	P.Perron test	-3,2560	-23,310	-6,330	-	-3,488	-2,887	-2,580	short term cycle

Second step is estimated using cointegration contrast (Johansen (1988,1991)), that allow to us to detect existence of long-time common behaviour and short run relations among variables. We use this technique to estimate (8) and (9). First we present cointegration test results for variables (exhibit 4), because it condition the functional form in each model. Then, we apply Error Correction Model to equation (8) and (9) in order to observe permanent and temporary components and to compare. Results of (8) are in exhibit 5 and for (9) in exhibit 6.

EXHIBIT 4.- COINTEGRATION TEST BETWEEN HOUSES AND REAL INTEREST RATES CHANGES
time series 1980.1-2001.2

Country	Are cointegrated?	How many?	Long term relationship
TREND: mt = f(ir)			
ITALY	YES	1	Hphita -34.455*dririta
PORTUGAL	YES	1	Hphpor +0.77485*drirpor
SPAIN	YES	1	hphsp+6.3287*drirsp
SHORT TERM CYCLE: ct = f(ir)			
ITALY	YES	1	Hcyita -1.92020*dririta
PORTUGAL	YES	1	Hcypor +1.2911*drirpor
SPAIN	YES	1	Hcysp - 2.2132*drirsp

Note that a cointegration relationship exists between cycles and changes on interest rates although cycles in Spain and Italy are stationary series.

In all VEC models we have selected the number of lags that give us an estimation without residual serial correlation, using LM test.

EXHIBIT 5.- MODEL RESULTS: LONG TERM TREND VS. CHANGES ON INTEREST RATES			
t statistics between brackets			
$hp_t = f(ir_t)$	**ITALY**	**PORTUGAL**	**SPAIN**
Sample	1982.2-1999.4	1996.2-2001.3	1981.3-2001.4
LM TEST for residual correlation:lags	7	7	7
Independent variable: d(hpt)			
Included observations:	71	24	99
long term parameter (coint)	-1.72E-06	-3.10E-06	9.19E-07
	[-2.20090]	[-0.23781]	[2.65765]
hp(t-1)	1	1	1
D(ir(t-1))	-172,1436	-20,8713	-284,1308
	[-5.02921]	[-3.59986]	[-5.54864]
Short run			
D(hp(t-1))	3,2288	2,8948	3,0488
	[24.8861]	[8.92106]	[29.7359]
D(hp(t-2))	-3,6482	-2,7701	-3,0256
	[-8.19564]	[-2.68000]	[-9.07117]
D(hp(t-3))	1,4654	0.524379	0.735481
	[2.19542]	[0.35628]	[1.57826]
D(hp(t-4))	-0.174628	0.937731	0.196906
	[-0.24504]	[0.66594]	[0.41389]
D(hp(t-5))	0.582677	-1,0368	0.365515
	[0.84787]	[-0.79116]	[0.78012]
D(hp(t-6))	-0.653220	0.591551	-0.444497
	[-1.44754]	[0.55623]	[-1.31779]
D(hp(t-7))	0.198404	-0.143477	0.123041
	[1.54111]	[-0.39656]	[1.17131]
D^2(ir(t-1))	-0.000241	-5.30E-05	0.000266
	[-1.89953]	[-0.21830]	[2.98730]
D^2(ir(t-2))	-0.000191	9.53E-06	0.000233
	[-1.66411]	[0.04391]	[2.92694]
D^2(ir(t-3))	-0.000122	3.54E-05	0.000227
	[-1.22473]	[0.18174]	[3.32092]
D^2(ir(t-4))	-6.39E-05	-5.04E-06	0.000207
	[-0.74798]	[-0.03114]	[3.57047]
D^2(ir(t-5))	-4.94E-05	1.89E-05	0.000152
	[-0.66443]	[0.15471]	[3.24845]
D^2(ir(t-6))	-5.31E-05	5.38E-05	0.000104
	[-0.88210]	[0.59480]	[3.08839]
D^2(ir(t-7))	-3.75E-05	1.31E-05	6.15E-05
	[-0.84330]	[0.24556]	[2.80483]
R2	0.999988	0.999995	0.999994
R2 adjust	0.999985	0.999987	0.999993
F-statist	329691.6	122074.2	960095.9

Log likelihood	631,9262	218,7545	863,2519

EXHIBIT 6.- MODEL RESULTS: SHORT TERM CYCLES VS. CHANGES ON INTEREST RATES
t statistics between brackets

$hp_t = f(ir_t)$	ITALY	PORTUGAL	SPAIN
Sample	1982.2-1999.4	1996.2-2001.3	1981.3-2001.4
Independent variable: d(hpt)			
LM TEST for residual correlation: lags	8	4	7
Included observations:	70	23	101
long term parameter (coint)	-0.198050	-0.336473	-0.325235
	[-3.90321]	[-2.96739]	[-2.93294]
cy(t-1)	1	1	1
d(ir(t-1))	3,8251	1,1321	1,0625
	[4.08959]	[3.46852]	[2.97669]
Short run			
D(cy(t-1))	-0.285650	-0.127316	-0.323650
	[-2.44647]	[-0.61199]	[-2.28117]
D(cy(t-2))	-0.157251	0.094478	0.163199
	[-1.29577]	[0.45876]	[1.09614]
D(cy(t-3))	-0.031613	-0.006803	0.183900
	[-0.26612]	[-0.03348]	[1.26100]
D(cy(t-4))	-0.219315	0.221178	-0.071778
	[-1.85894]	[1.04176]	[-0.53492]
D(cy(t-5))	-0.048236		0.150827
	[-0.42003]		[1.12086]
D(cy(t-6))	-0.334523		0.306997
	[-2.84995]		[2.31719]
D(cy(t-7))	-0.267937		0.111846
	[-2.17350]		[1.00791]
D(cy(t-8))	-0.364858		
	[-3.03119]		
D^2(ir(t-1))	0.711902	0.270619	0.266785
	[3.89059]	[2.47546]	[2.45577]
D^2(ir(t-2))	0.700584	0.158657	0.220361
	[3.93663]	[1.61225]	[2.24649]
D^2(ir(t-3))	0.599246	0.200328	0.242512
	[3.71975]	[2.33903]	[2.74039]
D^2(ir(t-4))	0.432642	0.148628	0.254838
	[2.96508]	[2.72937]	[3.21494]
D^2(ir(t-5))	0.326180	0.541264	0.228209
	[2.58244]	0.048117	[3.40065]
D^2(ir(t-6))	0.259534		0.219239
	[2.26471]		[4.23747]
D^2(ir(t-7))	0.228176		0.128190
	[2.43127]		[3.37270]
D^2(ir(t-8))	0.192250		
	[2.67797]		
R2	0.480091	0.541264	0.446578
R2 adjust	0.323137	0.325388	0.356486
F-statist	3,0588	2,5073	4,9569
Log likelihood	106,2612	44,9064	101,9140

Results show how a relationship exists, as literature maintains, between housing starts and changes on interest rates, with high level of sensibility in all cases. There are two time-patterns.

1.- **Trends models** shows a very stable and very elastic relationship between house-building process and changes on interest rates, with negative sign as we can expect if think that demand-side determinants are the main important to explain the long house wave. It means that an increase on interest rates reduce demand. Spain is the most sensible in this matter, followed than Italy, that it is reasonable knowing that interest rate to finance houses have had a very high rates historically, making very sensible to demand to changes on it.

- ❖ This stable relationship is significant in Spain and Italy during the analysed period (1980-2001), but not for Portugal because the lack on data.
- ❖ The pattern for short run is very different. Changes on trend are very related to deviation on interest rates only in Spain, and with a positive sign, having effects that can be extended until two years later. Second differences positives means if interest rates changes rise faster, then new housing units also increase and this differences levels of house building become a stable activity in construction. This short run effect can be picking up the incentives from the supply side in the long term. Value of coefficients are very low (close to zero), that mean this impact is marginal.
- ❖ In others two countries, the sign between interest rates changes and house-building changes is maintained negative and faster or slow changes on interest rate are not significant.
- ❖ Higher Spanish elasticity, its significance and the short term relationship in trend show us how shock occurs during nineties could have been an incentive to building behaviour showed during last nineties, becoming a share of the long term trend very fast and explaining the high construction rates during last years.

2.- **Short term cycles** shows a different pattern. In this case, cycles have an stable behaviour in terms on their dependence of interest rates changes (cointegration coefficients) and in the three countries are significant and with a positive sign, that means cycle could recover the supply-side impact of interest rates. Italian elasticity, in this case, is higher than Spain and Portugal (near to 1).

- ❖ However, long term relationship explains changes on starts with negative sign. It control the impact from the demand side, being more intensive in Spain and Portugal than in Italy.
- ❖ Cycle is very influenced by the acceleration of changes on interest rates (with positive sign) in the very short run and in all cases. Now, the effect seen in the

Spanish case inside the trend is repeated here generalising as a normal behaviour. It means that an increase (decrease) on the speed in interest rates changes, make rise (fall) the intensity on house-building in terms of number of new starts related to those started in previous period. It is, accelerate (reduce) the intensity on construction (supply side).

- Fall in interest rates have to have a negative impact on the cycle or have the effect to change the intensity on construction. Following this thought, fall in interest rates occurs during nineties have to affect negatively to new units because this cycle-link.
- Portugal has no so clear results, again because the lack of data and the fact of the data are concentrate on nineties.

Then,

- Cycles new units have a relationship with interest rates showing the reaction of the supply-side.
- Trend reflects the demand-side behaviour.
- Permanent impact in both models shows the most important elasticity, telling us from where the influences are acting.
- The rise in housing construction must be due to a higher impact from demand-side because the fall on interest rates, reducing the answer of the supply side.
    - Results for cycles are less meaningful than in the case of the trend (F statistic is so low).

- Models seem to be very similar across countries, more than we expected to find. Both trend and cycle equations shows a very close model in three countries. Then, results can explain why Spain and Portugal show the strong growth in housing starts during last nineties, but not for Italy and not at all in terms of quantifying the Spanish intensity on construction.
    - Italy shows negative impact on housing changes coming from an increase on interest rates inside trend (opposite than Spanish case). Then, fall on interest rates during nineties have to cause a positive change on housing starts intensity (short run effect on trend). Explanation can come from data, because we only observe housing starts until 1999, and perhaps the effects are not inside our sample.

- Lack of statistics for Portugal does not allow us to obtain robust results, but Portuguese pattern appears to be similar to the Spanish one.

To contrast the relevance of the EMU process, we have adjust a new model including a dummy variable named EMU that have value 1 between 1996 and 1999, and zero otherwise. Knowing cointegration relationship existing in the three countries, we have calculated a new variable that represents the long run cointegration on each model (trend and cycle for Italy, Portugal and Spain) named LR and adjusts using OLS to changes on housing starts, as a dependent variable, and including EMU, LR, interest rates in second differences with the lags adjusted previously, and an AR terms in order to reduce autocorrelation derived from missing components of changes on starts. Results are summarized in table 7.

EXHIBIT 7.- MODEL RESULTS: TREND AND CYCLES VS. CHANGES ON INTEREST RATES AND EMU- DUMMY

	Variables	LR-cont	EMU dumm	R2 adjust	F
ITALY					
TREND	β	-0.007974	-0.209945	0.798607	28,758
	t	-3,402	-5,328		
CYCLE	β	-0.240543	0.042482	0.362819	4,520
	t	-2,394	0.913357		
PORTUGAL					
TREND	β	0.005065	-0.113510	0.857613	19,069
	t	0.548511	-3,685		
CYCLE	β	-0.375242	-0.012781	0.489095	4,085
	t	-1,810	-0.255169		
SPAIN					
TREND	β	0.010511	0.394897	0.376437	6,433
	t	6,169	5,597		
CYCLE	β	0.460121	0.006796	0.209562	3,386
	t	4,939	0.255193		

In all models, trends of Spain and Italy show a significant relationship with dummy variable, but not in the case of any cycle. It seems to suggest that long run behaviour receive the impact of changes derived from EMU process, but it is not transmitted to cycle behaviour already.

5. - Conclusions

In this paper we have developed a time-series analysis focusing on the relationship between interest rates and housing cycle applied to the cases of Spain, Italy and Portugal. Following the theory, we have tried to contrast the impact of interest rates changes on housing starts, both in the short and long run, looking for the source of the influences. To do that, we have extracted unobserved components from housing starts data on trend and cycle and regressed both to changes on interest rates. Series calculated observe the statistical conditions to be analysed. All models defined are cointegrated and the VEC model is used for the analysis. Results shows how trend extracted in the three cases shows a very stable and significant and negative relationship with changes on interest rates in the long run, exhibiting higher elasticities reflecting fast reactions of the new units trend when interest rates change. It also shows a not significant relationship in the short run in Italy and Portugal, but not in the case of Spain, where positive changes on the second-differences of interest rates have a significant impact on the trend, but with a very low elasticity. It seems to reflect some answer from supply-side.

Cycles extracted shows a significant relationship linking changes on housing starts and interest rates, but inside a stable behaviour that shows how an increase on housing starts is related to rises on interest rates. In this case, the only more sensible model is for Italy. This positive behaviour is common for the three countries, with inelastic responses.

Conclusions are that the more sensitivity on Spanish case (higher elasticity on trend and positive relationship in the long run relationship) could explain the stronger housing starts cycle presented during nineties instead on Italy, with similar pattern but negative coefficient. This coefficient is reflecting the demand-side reaction that seems to be the most important sources of the housing demand last decade.

. Lack of statistics for Portugal do not allow us to obtain robust results

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